NORTH CAROLINA DEPARTMENT OF TRANSPORTATION (NCDOT) GUIDELINES FOR CONSTRUCTION OF INTELLIGENT COMPACTION (IC) TEST SECTIONS.

PURPOSE:

The purpose of test sections is to develop correlations between Intelligent Compaction Measurement Values (IC-MV) and single point tests such as density and plate Load tests. These correlations will be used to establish target IC-MV for Quality Assurance (QA) and acceptance of embankment compaction.

GENERAL CONSTRUCTION REQUIREMENTS:

The criterion for locating test sections is contained in the IC specifications. Borrow material for use in test sections should be as homogeneous as is practical. Good control of moisture content is essential. Compaction should be with the same equipment Contractor will use for production. Contractor should also minimize overlap of roller passes.

CONSTRUCTION PROCESS:

1. Compact test section using a single pass with the selected production roller.
2. Proof roll with a single pass of an IC smooth drum roller using the specified roller speed, drum weight, amplitude and frequency.
3. Provide access for single point testing by Quality Control Construction Engineering Inspection (QCCEI) and Department personnel.
4. After single point testing is complete, compact the test section with two more passes using the selected production roller (cumulative number of roller passes will be three).
5. Repeat steps 2 and 3.
6. Compact the test section with two more passes using the selected production roller (cumulative number of roller passes will be five).
7. Repeat steps 2 and 3.
8. Additional passes may be required if 95% of AASHTO T-99 density and a compression soil modulus of 6000 psi at a vertical stress of 15 psi is not achieved after five roller passes.
9. Repeat steps 2 and 3.

SINGLE POINT TEST LOCATIONS:

Single point tests are required at five (5) locations after roller passes 1, 3, 5 and any additional passes necessary to achieve 95% of AASHTO T-99 density and a soil modulus of 6000 psi at a vertical stress of 15 psi. Therefore, testing will be conducted at a total of at least fifteen (15) different locations. IC-MV obtained from each IC proof roll operation will be analyzed using the Veda software and frequency histograms will be generated. The IC-MV should be averaged over a distance of three (3) feet in the direction of IC roller travel to generate the IC-MV for use in the analysis. Based on the results of the frequency histograms, averaged ICMV corresponding to the following percentile ranges will be obtained: 0-20, 20-40, 40-60, 60-80, and 80-100. One test location must fall within each of these percentile ranges. In the longitudinal direction the test section should be divided into five subsections of one hundred feet each and there should be one test location per subsection. In the Transverse direction, the test section should be divided into two equal halves and there should be at least two test locations in each half after passes numbers 1, 3, 5 and any additional passes necessary to meet specifications. Figure and table 1 are examples of selection of single point test locations.

REQUIRED SINGLE POINT TESTS:

The following in-situ tests are required at each single point test location:

1. In-situ Wet Density Test:

Determine in-situ wet density to a depth of 12 inches using a Portable Nuclear Density Gauge with a current calibration.

2. In-situ Moisture Content Test:

Determine in-situ moisture content to a depth of 18 inches using procedures described in the latest edition of the Conventional Density Manual. This manual is provided by the Materials and Tests Unit.

3. Estimated Optimum Moisture Content Test (OMC):

Determine an estimated optimum moisture content using procedures described in the latest edition of the Conventional Density Manual. This manual is provided by the Materials and Tests Unit.

4. Maximum AASHTO T-99 Dry Density Based on Estimated OMC:

To determine maximum dry density, compact a one-point proctor based on the estimated optimum moisture content using procedures described in the latest edition of the Conventional Density Manual. This manual is provided by Materials and Test Unit

5. Repetitive Static Plate Load Test:

This test is conducted in accordance with NCDOT Method of Test for Repetitive Static Plate Load Test of soils dated January 30, 2012. This document is available at NCDOT Geotechnical Engineering Unit (GEU) website. The Department provides QCCEI team with an excel program that will process, analyze and present data in the format required by the Department. The Zip file of this program is also available at GEU website. For the purpose of developing correlations, the QCCEI team should use values of compression soil modulus computed using an axial stress of 15 psi.

AASHTO T-99 Moisture Density Characteristics Test:

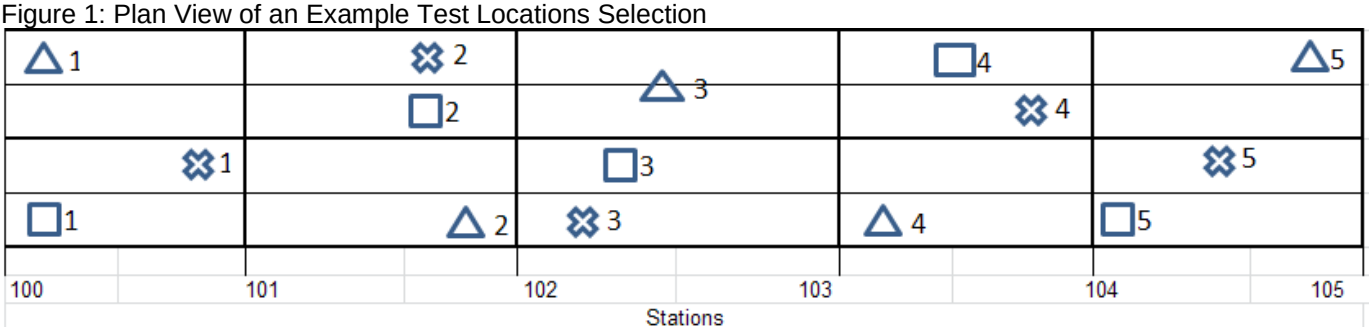
One AASHTO T-99 Moisture Density Characteristics test is required for every 5 single point test locations. Perform the test using procedures described in the latest edition of the Conventional Density Manual. This manual is provided by the Materials and Tests Unit.

The sampling locations for these tests will be at the discretion of the contractor but will be from the single point test locations.

Table 1: Stations & IC-MV Percentile Range for Test Locations

After Roller Pass #1			After Roller Pass #3			After Roller Pass #5		
Test Loc.	Station	Percentile Range(IC-MV)	Test Loc.	Station	Percentile Range(IC-MV)	Test Loc.	Station	Percentile Range(IC-MV)
1	100+80 R	60- 80	1	100+20 L	40 - 60	1	100+20 R	80 - 100
2	101+50 L	40 - 60	2	101+70 R	60 - 80	2	101+60 L	0 - 20
3	102+25 R	0 - 20	3	102+60 L	20 - 40	3	102+40 R	40 - 60
4	103+75 L	20 - 40	4	103+25 R	0 - 20	4	103+50 L	20 - 40
5	104+50 R	80 - 100	5	104+90 L	80 - 100	5	104+10 R	60 - 80

Figure 1: Plan View of an Example Test Locations Selection



Key:

Locations after roller pass #1

Locations after roller pass #3

Locations after roller pass #5

Test locations are well distributed throughout the test sections.

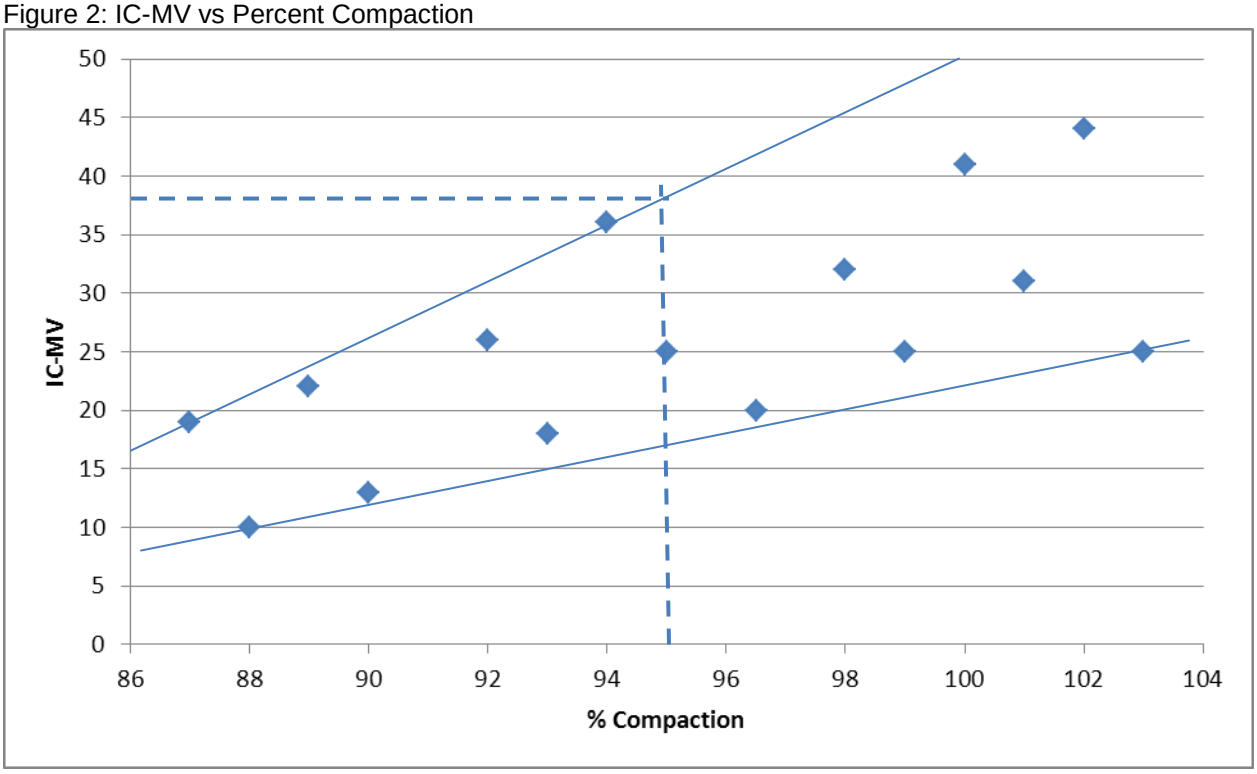
DATA ANALYSIS AND PRESENTATION:

1. Plot two graphs, one for IC-MV vs. Percent Compaction and the other one for IC-MV vs. Compression Soil Modulus at an axial stress of 15 psi.
2. Draw an upper and lower envelope of the data on each graph.
3. From the IC vs. Percent Compaction graph, select the IC-MV that corresponds to the intersection of the upper envelope line and the 95% compaction line. Select this as a potential target IC-MV.
4. From the IC-MV vs. Compression Soil Modulus graph, select the IC-MV that corresponds to the intersection of the upper envelope line and the 6000 psi Compression Soil modulus line. Select this as another potential target IC-MV.
5. Compare potential target IC-MV obtained in steps 3 and 4 and use the greater of the two for target IC-MV.
6. Tables and figures 2, 3, and 4 are examples of expected analysis.

Table 2: IC-MV vs Percent Compaction

IC-MV	%
19	87
10	88
22	89
13	90
26	92
18	93
36	94
25	95
20	96.5
32	98
25	99
41	100
31	101
44	102
25	103

Figure 2: IC-MV vs Percent Compaction



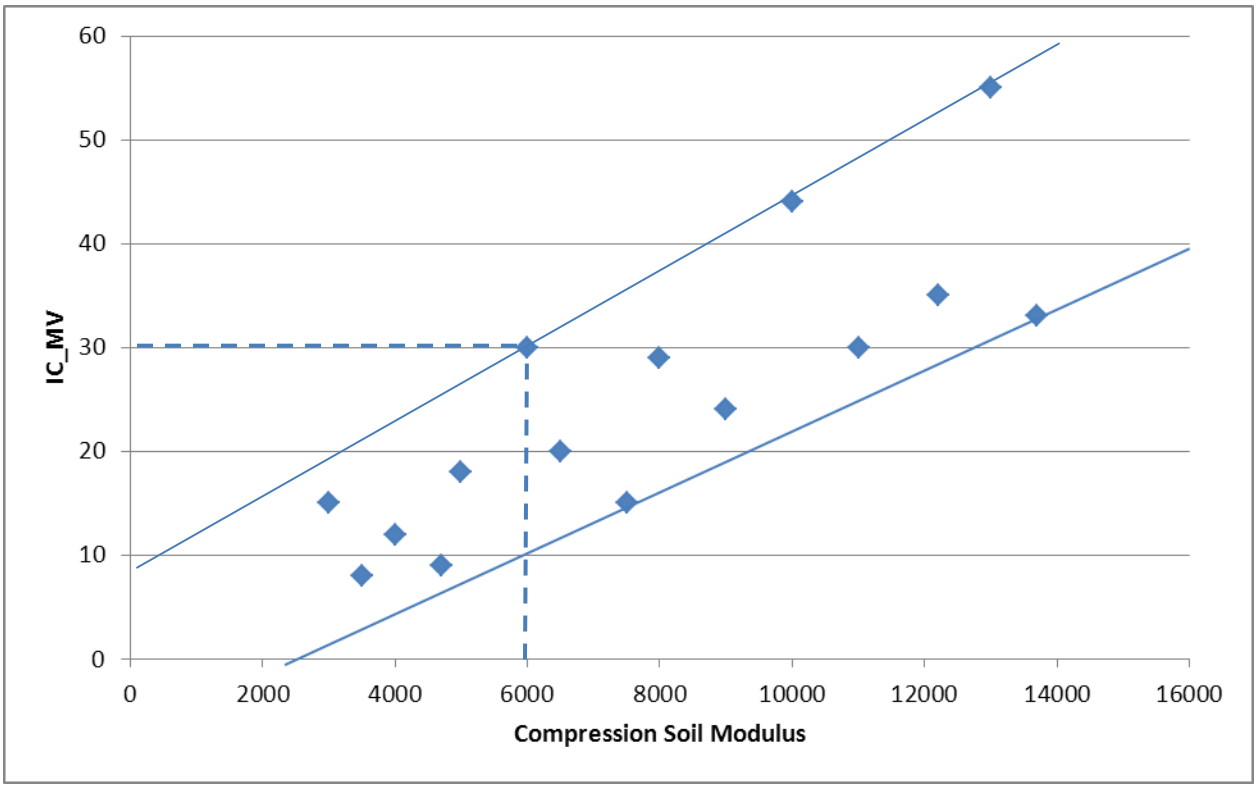
Notes: Target IC-MV=38

Values are not from actual test.

Table 3: IC-MV vs. Compression Soil Modulus

IC-MV	Modulus
15	3000
8	3500
12	4000
9	4700
30	6000
20	6500
15	7500
29	8000
24	9000
44	10000
18	5000
30	11000
35	12200
55	13000
33	13700

Figure 3: IC-MV vs. Compression Soil Modulus



Notes: Potential target IC-MV is 30
Target IC-MV=38, since 38 from figure 2 is greater than 30 from figure 3.
Values are not from actual tests.